application bulletin

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E. M. L.
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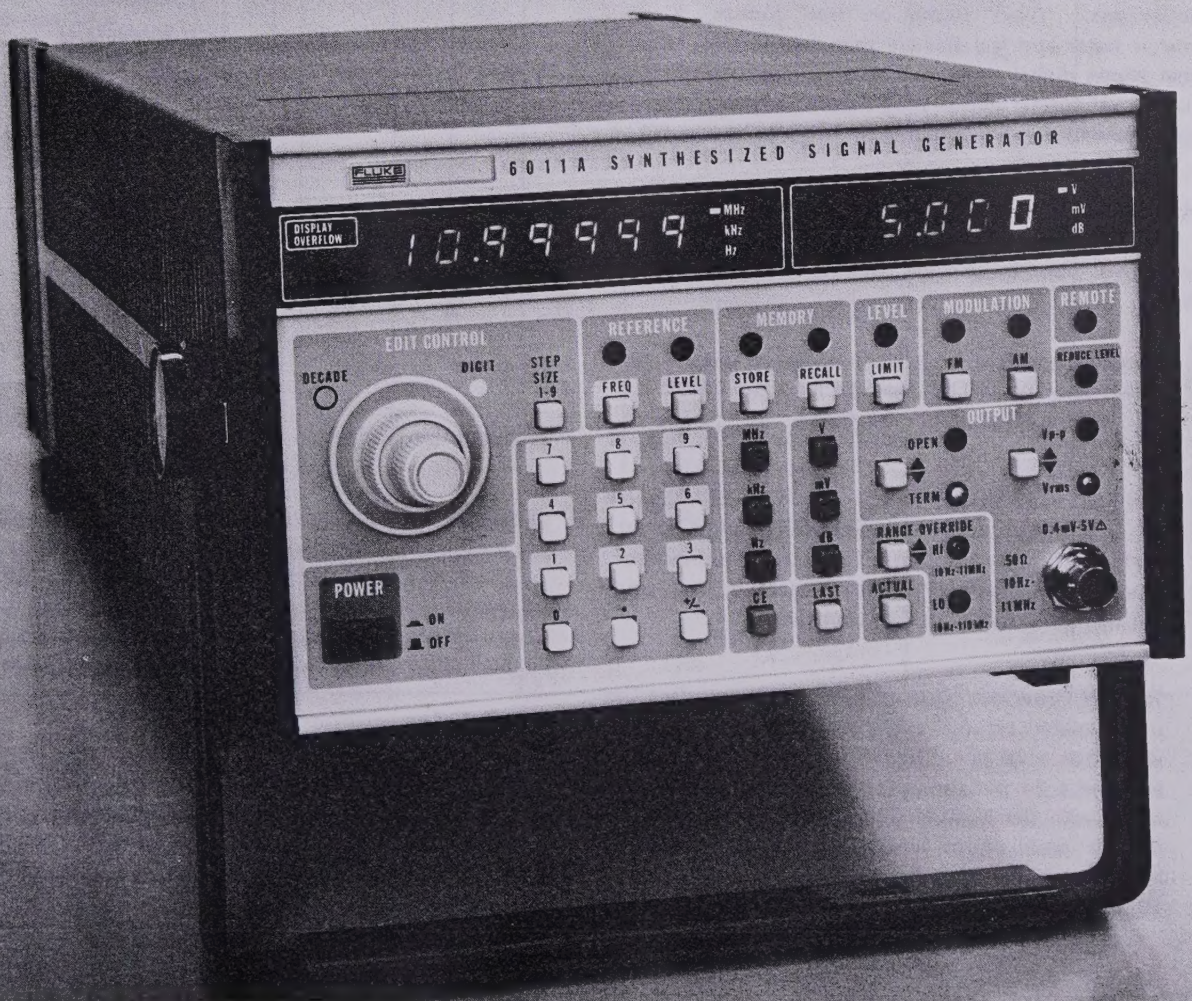
Systems use of the 6011A Synthesized Signal Generator



INTRODUCTION

The 6011A Synthesized Signal Generator can be programmed using either of two formats (or instruction sets) and either of three interfaces: standard, IEEE-488 or RS-232C. The standard 6011A is equipped with a Fluke defined interface consisting of a two-wire handshake with seven ASCII defined data lines. Data is transferred into the 6011A in seven bit bytes, i.e., character serial.

Option 05 is the IEEE standard digital interface for instrumentation. This interface is defined in IEEE STD 488-1975.

Option 06 is the RS-232C bit serial interface and is defined in EIA publication RS-232C.

These interfaces are mutually exclusive, that is, only one may be installed in a given instrument.

Field installation of options –05 and –06 is possible, Order 610/11 –05K or 610/11–06K.

PROGRAMMING FORMATS:

The 6011A may be programmed using either of two instruction sets: "fixed" format or "free" format. Fixed format is faster and less flexible than free format. Free format allows digital programming of all front panel functions. Fixed format allows programming of frequency, range, modulation, and output level in volts behind 50Ω.

FIXED FORMAT

Fixed format must be selected over free format as follows:

(1) Standard Interface - Pin 19 on Remote Control connector (rear panel, J4) must be left open on in a TTL high condition (> 2.4 VDC).

(2) IEEE STD-488-1975 Interface (Option –05) - Switch S1 on the interface card (6010A-4008) must be set to Fixed Format position. This card is located behind the front panel PCB and is accessible by removing the top cover of the instrument.

(3) RS-232C Interface (Option –06) - This interface has an associated external cable assembly (6010A-4456) which has a 25 pin RS-232C connector (J2) on one end and a 24 pin connector (J1) on the other. J1 mates with the Remote Control connector (J4) on the rear panel of the synthesizer. In order to select fixed format, cut the jumper wire between pin 19 and pin 11 on J1.

Frequency Programming

Each decade of frequency is individually addressed in fixed format. Refer to Table 1. The frequency control register is addressed by ASCII characters A through G.

Data in the frequency control register will remain there until written over or the synthesizer power is shut off. It is, therefore, not necessary to re-enter data in decades that remain unchanged. Example: present frequency 10.7 MHz; send A0; frequency now 0.7 MHz.

Example:

The generator is already operating at a frequency of 10 MHz, and it is desired to change to a frequency of 9.87654 MHz. Below is a sequence of frequency commands versus actual otuput frequency.

Character Sequence	Actual Output Frequency
A	10.00000 MHz
0	00.00000 MHz
B	00.00000 MHz
9	9.00000 MHz
C	9.00000 MHz
8	9.80000 MHz
D	9.80000 MHz
7	9.87000 MHz
E	9.87000 MHz
6	9.87600 MHz
F	9.87600 MHz
5	9.87650 MHz
G	9.87650 MHz
4	9.86654 MHz

Frequency Range

There are two frequency/resolution ranges (bands) that may be selected by the appropriate numeric following the letter J. Refer to Table 1. When ASCII data bit 3 is not true, the generator is in low range (10 Hz - 109.9999 kHz in 0.1 Hz steps). When ASCII data bit 3 is true, the generator is placed in high range (10 Hz to 10.99999 MHz in 10 Hz steps).

Modulation

AM and FM conditions may be selected by sending the appropriate numeric following the letter J. Refer to Table 1. If ASCII data bit 2 is true, FM is on, and if it is not true, FM is off. If ASCII data bit 1 is true, AM is on and if it is not true, AM is off.

TABLE 1. 6011A FIXED FORM CHARACTER DEFINITIONS

Addressed Position	Octal Equiv.	ASCII Address Char.	Typical Processing Time (mS)	Following Numeric (ASCII Char.)	Typical Processing Time for Numerics (mS)	ASCII to Octal Relationship For Numerics
Frequency						ASCII Octal
High Band **Low Band**						
10 MHz 100 kHz	101	A	0.93	0 or 1	1.26	0 060
1 MHz 10 kHz	102	B	"	0 thru 9	"	1 061
100 kHz 1 kHz	103	C	"	0 thru 9	"	2 062
10 kHz 100 Hz	104	D	"	0 thru 9	"	3 063
1 kHz 10 Hz	105	E	"	0 thru 9	"	4 064
100 Hz 1 Hz	106	F	"	0 thru 9	"	5 065
10 Hz 0.1 Hz	107	G	"	0 thru 9	"	6 066
						7 067
						8 070
						9 071
						? 077
						CR 015
						LF 012
FM, AM & Range	112	J	"	ASCII Char. / Freq. Range / FM / AM 0 Low Off Off 1 Low Off On 2 Low On Off 3 Low On On 4 High Off Off 5 High Off On 6 High On Off 7 High On On	1.65	
Output Level						
1V	121	Q	1.0	2 thru 9 (Equivalent to Vrms behind 50Ω)	1.24	
100 mV	122	R	"	0 thru 9	"	
10 mV	123	S	"	0 thru 9	"	
1 mV	124	T	"	0 thru 9	"	
100 uV	125	U	"	0 thru 9	"	
Attenuator						
(10 dB steps)	127	W	0.98	ASCII Char. / Attenuation 0 0 dB X 1 1 10 dB X 0.3162 2 20 dB X 0.1 3 30 dB X 0.03162 4 40 dB X 0.01 5 50 dB X 0.003162 6 60 dB X 0.001 7 70 dB X 0.0003162	1.25	
Clear (Clears all data entered)	120	P	15.8	None		

AM		FM		
Instantaneous Modulating Voltage During AM	Resulting Output Voltage rms terminated., (2.5V rms nominal)	Instantaneous Modulating Voltage During FM	Resulting Nominal Output Frequency Deviation	
			Hi Band	Lo Band
> +4.5	not defined	+ 5	+20 kHz	+200 Hz
+4.5	4.75	+4.5	+18 kHz	+180 Hz
+3	4.0	+3	+12 kHz	+120 Hz
+2	3.5	+2	+ 8 kHz	+ 80 Hz
+1	3.0	+1	+ 4 kHz	+ 40 Hz
+0.25	2.625	+0.25	+ 1 kHz	+ 10 Hz
0	2.5	0	0	0
−0.25	2.375	−0.25	− 1 kHz	− 10 Hz
−1	2.0	−1	− 4 kHz	− 40 Hz
−2	1.5	−2	− 8 kHz	− 80 Hz
−3	1.0	− 3	−12 kHz	−120 Hz
−4.5	0.25	−4.5	−18 kHz	−180 Hz
< −4.5	not defined	−5	−20 kHz	−200 Hz

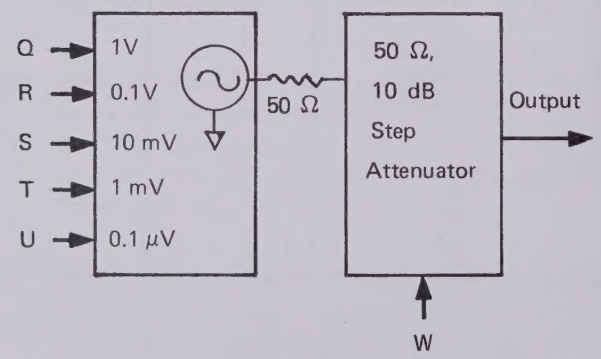
Input impedance is 600 ohms for both AM and FM.

Clear

The ASCII character P will clear all data entered. It is not necessary to use this command to enter new data as data in each register is written over. P is useful when transient levels must be avoided during new command sequences.

Level Control

The level control system of the 6011A in fixed format is represented schematically below:



The generator may be thought of as a zero impedance source behind a 50 ohm resistor, followed by a zero to seventy dB attenuator in 10 dB steps.

The voltage range of the imbedded source is from 2.5119V rms to 9.9999V rms. Each decade of level is addressable by the ASCII characters Q through U. (See Table 1).

The 10 dB step attenuator is addressed by the letter W followed by a number 0 through 7 (See Table 1).

The source is normally programmed over a 10 dB range from 2.5119V rms to 7.9419V rms. The only exception to this is when an output level higher than 3.971V rms terminated (source > 7.942V rms) is desired at the output of the instrument. The source may then be programmed higher than 7.9420V rms. Harmonics higher than −40 dB will result if this limit is exceeded when the frequency is between 5 and 11 MHz.

Example:

Output of 6011A is terminated in 50 ohms with 2.000V rms across it. It is desired to change this voltage to 0.9876V rms. The desired voltage lies within the range where 10 dB of attenuation must be used. To compute the command to the imbedded voltage source, double the desired terminated voltage and divide by the attenuator factor:

$$\frac{0.9876 \times 2}{0.31623} = 6.2461$$

Therefore, the command string would be:

W1 Q6 R2 S4 T6 U1

ATTENUATOR VERSUS LEVEL RANGE

Command	Attenuation in dB	Output Level Range Term	Open
W0	0	5.000V rms	10.00V rms
	0	1.256V rms	2.512V rms
W1	10	1.255V rms	2.510V rms
	10	397.2mV rms	794.4mV rms
W2	20	397.1mV rms	794.2mV rms
	20	125.6mV rms	251.2mV rms
W3	30	125.5mV rms	251.0mV rms
	30	39.72mV rms	79.44mV rms
W4	40	39.71mV rms	79.42mV rms
	40	12.56mV rms	25.12mV rms
W5	50	12.55mV rms	25.10mV rms
	50	3.972mV rms	7.944mV rms
W6	60	3.971mV rms	7.942mV rms
	60	1.256mV rms	2.512mV rms
W7	70	1.255mV rms	2.510mV rms
	70	.3972mV rms	.7944mV rms

These commands are sent to the voltage source immediately.

New Command Sequence	Actual Output Voltage
W	2.00000V rms
1	0.63246V rms
Q	0.63246V rms
6	0.94869V rms
R	0.94869V rms
2	0.98031V rms
S	0.98031V rms
4	0.98664V rms
T	0.98664V rms
6	0.98759V rms
U	0.98759V rms
1	0.98760V rms

In the same manner as with frequency programming, data is stored in each address location until written over or power is turned off.

D/A Settling Time

In addition to the processing time listed in Table 1, the Digital to Analog converter used to control the voltage has a settling time of about 360 milliseconds. This settling time is signalled on the standard interface and RS-232C interface (see appropriate sections).

Allowing time for the D/A to settle after each command we have listed the actual output voltage versus command sequence for the example cited previously.

FREE FORMAT

Free format programming mode must be selected over fixed format by the following means:

(1) Standard Interface - Pin 19 on the remote control connector (J4 on rear panel) must be grounded or held below 0.8V dc by a TTL gate.

(2) IEEE-STD-488-1975 interface (Option –05) - Switch S1 on the interface card (6010A-4008) located behind the front panel must be set to the FREE position. Top cover of instrument must be removed for access.

(3) RS-232C Interface (Option –06) - Pin 19 on J2 (24 pin connector) of adapter cable assembly 6010A-4456, must be connected to pin 11. This cable is manufactured with these pins connected, and this can be verified by checking continuity with an ohmmeter.

Scientific Notation

Free form entry of frequency or level may be made in scientific notation using the ASCII character E.

Examples:

1,000,000	=	1E6
2,000	=	2E3
0.03	=	3E-2
2345670	=	2.34567E6

The range of powers of 10 is from minus 9 to plus 9.

Frequency Programming

Frequency data is entered by sending a string of numerics followed by an H (signifies Hz). See Table 2.

Example:

All of the following result in an output frequency of 1 MHz:

1E6H 01E6H 1.0E6H

Leading and trailing zeroes, blanks, spaces, carriage returns, line feeds, and rubouts are ignored.

Frequency Range

If the commanded frequency is less than 110 kHz, the low range will be selected automatically. By sending the letter U, this selection may be overridden to place the unit in high band. U may be sent in advance of, or subsequent to, the H frequency character. Override of low range must be done when the frequency is being edited (swept using letter I) across the 110 kHz range boundary.

Likewise, the letter L will change the range from high to low, but only when the output frequency is below 110 kHz.

Frequency Editing

It is possible to remotely increment or decrement the frequency command to the generator in the same manner as with the front panel edit controls. The decade to be edited is designated by the letter G followed by a number from 1 through 7. See Table 2. Every time the letter I or D is sent, that decade increments or decrements by 1 unless the step size has been set to another integer. It is, therefore, possible to sweep the frequency of the 6011A by sending a string of I's or D's.

Step Size

The amount that the designated frequency or level decade will increment or decrement with each I or D is governed by the Step Size Function. The ASCII character X followed by a number from 1 through 9 will set the step size to that number. Step size is set to 1 when the generator is turned on. The step size character X is mutually exclusive with the Store (S) and Recall (R) functions.

Application Suggestion

Frequency Edit Function: The "I" and "D" characters may be used in an iterative process to bring the frequency of the synthesizer to a desired value.

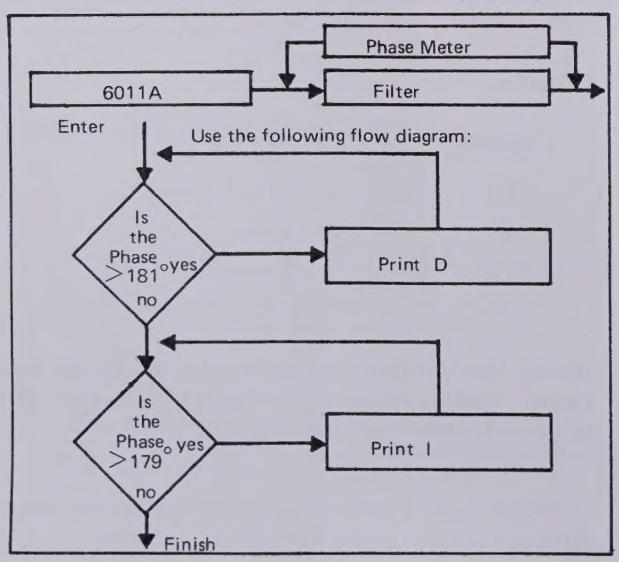
Example: It is desired to set the frequency of the generator such that the phase shift through a filter is 180 degrees ±1 degree.

Table 2. 6011A FREE FORM CHARACTER DEFINITIONS

Addressed Position	Octal Equiv.	ASCII Address Char.	Typical Processing Time (mS)	Associated Numeric (ASCII Char.)	Typical Processing Time for Numerics (mS)	Octal to ASCII Relationship for Numerics
AM: Amplitude Modulation	101	A(n)	0.3	n = 0 = AM Off n = 1 = AM On	7.8	
Decrement: decreases edited digit for each "D" sent.	104	D	33.5 for freq. 80 for vlts 200 for dB	None		
Exponent of 10: calls for scientific notation of the input digits. Negative exponents may be entered by sending a minus sign immediately after the E, then the exponent's integer value.	105	E(n)	0.3	Following numeric may range from 9 to –9.	1.2	060 0 061 1 062 2 063 3 064 4 065 5 066 6 067 7 070 8 071 9
FM: Frequency Modulation	106	F(n)	0.3	n = 0 = FM Off n = 1 = FM On		074 < 075 = 076 >
Select Frequency: selects edit decade in frequency display	107	G(n)	0.3	109.9999 Freq. display n 123 4567	2.5	077 ? (Question Mark) 015 CR (Carriage Return) 012 LF (Line Feed)
Hz: Hertz	110	(n) H	22	See text for formats of preceding numerics	1.5, except first numeric in sequence is 2.5	

Table 2. 6011A FREE FORM CHARACTER DEFINITIONS (Cont.)

Addressed Position	Octal Equiv.	ASCII Address Char.	Typical Processing Time (mS)	Associated Numeric (ASCII Char.)	Typical Processing Time for Numerics (mS)	Octal to ASCII Relationship for Numerics
Increment: Increases edited digit for each "I" sent.	111	I	33.5 for freq. 80 for volts 200 for dB	None		
Low Range: selects low range	114	L	18	None		
Recall: from storage	122	R(n)	1.1	1 thru 9 are storage locations < Level Limit Location = Reference Level Loc. > Reference Freq. Loc.	95 if level stored as voltage, 215 if level stored as dB.	
Store: in numbered, level limit or reference locations.	123	S(n)	0.3		5.6	
High Range: Selects high range	125	U	18	None		
Volts: selects level in volts or relative volts	126	(n)V	31 (36 if AM is on)	See text for formats of preceding numerics	1.5 except first numeric in sequence is 2.5	
Select Level: selects edit decade in level display	127	W(n)	0.3	5.000 Level Display n 1 234	2.6	
Step Size: selects amount that an edited digit will change when "1" or "D" is sent.	130	X(n)	0.3	1 thru 9	1.2	
Decibel: slcts level in dBm or relative dB	131	(n)Y	215	Numerics may range from +81.99 to −81.99; see text.	1.5, except first numeric in sequence is 2.5	
Plus Sign: modifiers for	053	+	1.25			
Minus Sign: numeric	055	−	1.25			
Decimal Point: entries	056		1.6			



Storage and Recall From Memory

There are 9 memory locations in the 6011A. Each memory location will store the following parameters simultaneously: frequency, modulation, output level setting, and high/low band. To store a group of parameters send S, followed by the location 1 through 9. To recall from memory, send R and the desired location 1 through 9.

Data may be stored in memory manually and recalled under remote control, and vice versa. The memory registers must be written over to erase, or the power turned off.

The recall function operates in the same manner as the front panel, e.g., the character sequence R123R results in Recall mode being set, then the contents of locations 1, 2, and 3 being called. The final R exits from or terminates the Recall mode. R, S, and X characters toggle on and off, and are exclusive, i.e., if R is set, an X will reset R and set X.

This brings up the question of how is one to be certain of which mode one is in, since there is no provision for interrogation of the status of these functions. When entering a mode, send another character prior to the desired one.

Example:

to enter	send
Recall	SR
Store	RS
Step Size	SX

This assures that you have not exited the mode you intended to enter.

To be certain you are not in S, R, or X modes prior to entering a new frequency or level string, send RXX. This assures that no modes are active.

Other Storage Functions

Reference frequencies and levels, and level limits are handled in the same manner as on the front panel. (Refer to Table 2).

Examples:

(1) It is desired to store 10.7 MHz and 1 Volt rms as reference frequency and level.

Sequence of Commands	Meaning
10.7E6H	enters 10.7 MHz
1 V	enters 1 Volt
S >	stores 10.7 MHz as ref. freq.
S =	stores 1 Volt as ref. level

(2) It is desired to set a level limit of +13 dBm, and a reference level of 223.6 mV.

Sequence	Meaning
13Y S <	enters +13 dBm, stores as limit
223.6E - 3V S =	enters 223.6mV, stores as ref. level

NOTE: When storing level limits and reference levels simultaneously, the level limit must be entered first.

To exit from level limit, or reference frequency and level, send just the character used as an address location (<, >, =)

Example:

Store 455 kHz as reference frequency, then exit from reference frequency mode.

455E3H	enters 455 kHz
S >	stores as reference frequency
>	eliminates reference frequency

The actual output frequency is now 0 kHz.

NOTE: An invalid frequency will result when exiting from reference frequency mode with a negative relative frequency command present.

Example:

Set –3.3 kHz from a 455 kHz center freqeuncy, then exit from reference frequency mode.

Sequence	Meaning	Actual Output Frequency	Display
455E3H	enter 455 kHz	455 kHz	455 kHz
S >	store as ref.	455 kHz	0 kHz
–3.3E3H	enter –3.3 kHz	451.7 kHz	–3.3 kHz
>	exit from ref.	451.7 kHz	–3.3 kHz (flashing)

A valid frequency must be entered to correct this condition.

Voltages less than 0.3972 mV rms terminated are invalid, and exit from reference level mode to such invalid levels should be avoided.

Modulation

AM and FM may be enabled or disabled remotely. The letter A followed by 1 will turn AM on; A0 will turn AM off. The letter F followed by 1 will turn FM on, if option –03 is installed. F0 will turn FM off.

Output Amplitude Control

Output level may be commanded in either dBm, relative dB, volts or relative volts. See Table 2.

Examples:

Sequence	Meaning
13.01Y	+13.01 dBm
3 V	3 volts
3E-3V	3 millivolts
–55Y	–55.00 dBm

Relative level programming is discussed in the Storage/Recall section. Negative voltage values may be entered when referred to a stored reference voltage.

It is not possible to program voltage peak-to-peak or unterminated as is possible via the front panel.

INTERFACES

As mentioned earlier, there are three interfaces available with the 6011A: IEEE-488, RS-232C, and a Fluke-defined parallel ASCII interface. All interfaces use the same programming formats discussed earlier.

Choice of Interface

In order to help the user in selection of an interface, we have listed controllers appropriate to each interface.

Standard Interface

- Paper tape reader with parallel output
- ASCII keyboard with parallel output
- Microprocessor Software Development machines such as:
  - Intellec 4 or 4/40 by Intel
  - Intellec 8 or 8/80 by Intel
  - Motorola Exorcisor for 6800 series
- Peripheral Controller cards from minicomputers, such as:
  - DR11C card for DEC PDP-11
  - HP12556 microcircuit interface for HP computers
  - 4041/4040 16 bit I/O for Data General Nova/Super Nova series machines

IEEE-488 Interface (Option –05)

- Tektronix 4051 Graphic System
- HP 9800 Series calculators
- Keithley System One with 7802-ISB card
- Compucorp Model 425-IS calculator

RS-232C Bit-Serial Interface (Option –06)

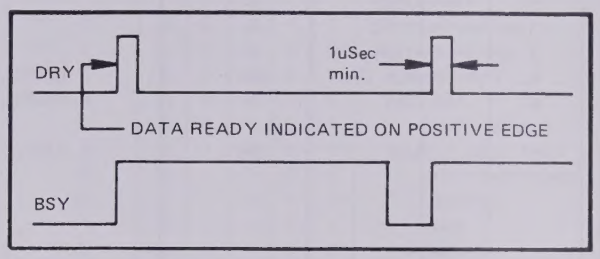
- Teletype machines (Model 33, 35, 37)
- CRT Terminals
- Data Modems
- Virtually any minicomputer with appropriate interface card.

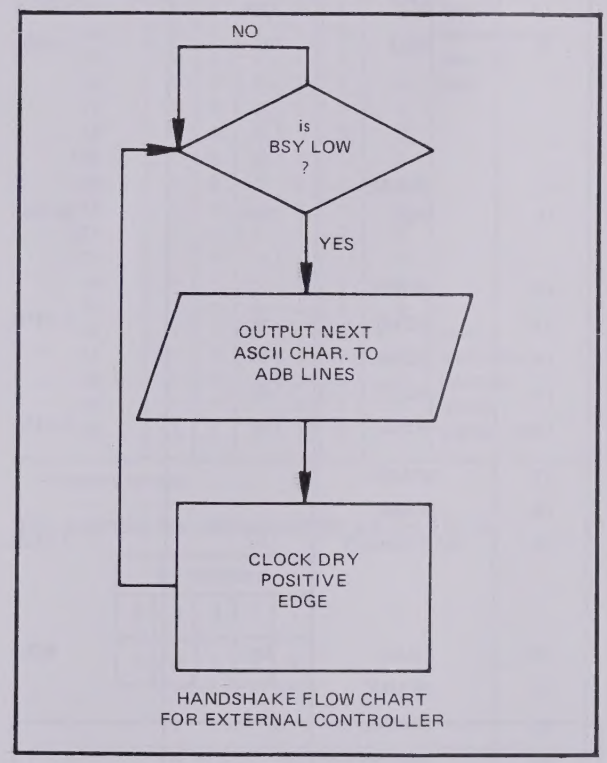
Standard Interface (Fluke - defined)

Refer to pin connections of the remote connector in Table 3. This interface uses 7 parallel ASCII defined data lines controlled by two handshake lines. ASCII data bit 8 (or parity bit) is ignored. ADB1 is least significant bit, ADB7 is most significant.

Logic family is TTL. A true condition (or 1) is indicated by a voltage level from +2.4VDC to +5VDC. A not-true condition (or 0) is indicated by a voltage from 0 to +0.8VDC. Gate load represented by each input and sink capabilities of outputs are listed in Table 3. All inputs have 10 kΩ pullup resistors. 1GL = 1.6 mA.

When the data at remote connector is to be read, the controller raises the DRY(Data Ready) line high for a period of at least one microsecond. When DRY goes high, the BSY, (Busy) line will go high and remain high for as long as the data is required to be held on the data lines. Refer to the timing diagram below:





HANDSHAKE FLOW CHART
FOR EXTERNAL CONTROLLER

Internal Processing Time

Refer to Tables 1 and 2. Typical processing times for each character are listed. The busy flag will go away prior to processing being completed. If new data is presented while the previous character is being processed, the BSY line will go high and remain high during this processing time, as well as during the interval when the new data is read. The $\overline{PRD}$ strobe may also be used as an indication that the unit is ready for more data, since it always occurs after the data has been read.

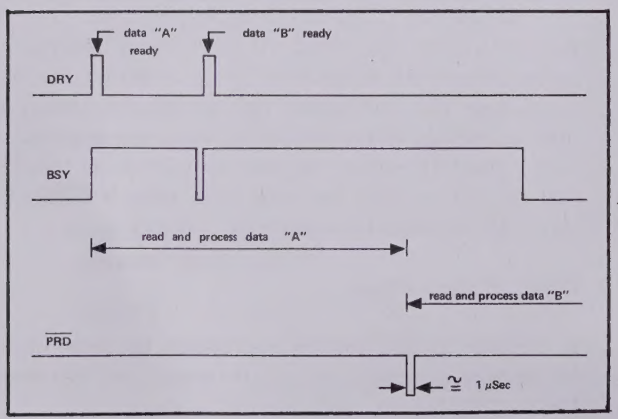
Other Status Flags

In addition to BSY and $\overline{PRD}$, provision has been made for flagging of power, settling of output, and AM overload.

Table 3. REMOTE CONTROL CONNECTIONS FOR STANDARD INTERFACE.

Pin No.	Function	Input or Output	# of Std. TTL Gate loads that function will present or sink	Description
1	ADB1	In	1.31GL	Four of eight ASCII Data Bit Input lines
2	ADB2	In	"	
3	ADB3	In	"	
4	ADB4	In	"	
5	POWER ON	Out	1.0 GL	+5 volt indicates 6011A power is on. Low indicates power off.
6	DRY	In	0.42GL	Data Ready: positive edge indicates that te input data is ready for transfer. Must stay high for at least 1 μ Sec.
7	BSY	Out	2.8GL	Busy indication: high true indication that the 6011A is busy reading the input data. *NOTE* *The input data to the 6011A must be held constant until the BSY line goes low*
8	$\overline{\text{PRD}}$	Out	2.5GL	Processor Done Strobe: low = processor done $\approx$1 μ Sec wide.
9	$\overline{\text{REM}}$	In	1.43GL	Remote control order: low true input to order 6011A remote operation. *NOTE* *When 6011A is placed in remote, any character sent within 2 msec, will not be recognized. This can be avoided by sending a dummy character.*
10	SPARE			Do not use.
11	ROL	Out	10 GL	Reduce output level: high true indication that the 6011A is being amplitude modulated to produce an output beyond the range of the internal circuitry.
12	SPARE			
13	ADB5	In	1.31GL	Four of eight ASCII Data Bit input lines.
14	ADB6	In	"	
15	ADB7	In	"	
16	ADB8	In	0.31GL	ASCII Data Bit 8 is ignored. It is tied thru a 10 kΩ resistor to +5V dc.
17	SPARE			
18	SPARE			
19	RC FORMAT	In	1.31GL	Remote Control Format: fixed form remote control is called when pin 19 is open or high. Free form remote control is called when pin 19 is pulled low. May not be changed while in Remote.
20	DAS	Out	8GL	D/A Converter settling: high when output level not settled $\approx$ 360 m Sec.
21	SPARE			
22	SPARE			
23	SPARE			
24	GND			Ground: provides a connection to 6011A logic common.

(Remote Connector Information: the remote connector on the rear of the 6011A is an Amphenol 24 pin Micro Blue Ribbon with wire hold-down bales. The mating connector is an Amphenol 57-30240 (Fluke Part no. 272427).



Power on/off is indicated on pin 5. Low is off, +5 volts is on.

When the D/A converter status is changed by a new level command, a 360 millisecond positive going flag is generated on pin 20 to indicate that the D/A is settling. This is the DAS function.

When AM is enabled and too much modulating signal is being applied to the internal attenuator, the ROL flag will go high. This indicates that the output level must be reduced so that the positive peaks of the modulating envelope will not be distorted. This function is on pin 11.

IEEE STD 488-1975 Interface

This interface is Option –05 and allows compatibility with the IEEE Standard Digital Interface for Programmable Instrumentation. This standard was formerly known by such names as IEC Bus, HP-IB, and GP IB. ASCII Bus is a name frequently misapplied to the IEEE-488 Interface standard. While IEEE-488 does define some interface messages in terms of ASCII, the standard does not speak to coding of data. Rather than go into a detailed discussion of the Standard, the reader is referred to the actual publication itself, published by:

The Institute of Electrical and Electronic Engineers, Inc.
345 East 47th St., New York, N. Y. 10017

Message Paths and Bus Structure

(Reference: paragraph 1.4.3, page 11 of IEEE-488)

The 6011A is a listen only device with EOI and SRQ lines neither used nor recognized, D108 is not recognized as a data bit.

Interface Function Repertoire

(Reference: paragraph 2.1.2.3, page 13)

The 6011A has the followng interface functions:

Acceptor Handshake	AH1
Listener	L2
Remote Local	RL 2

All other functions are zero.

Listen Addresses

(Reference: paragraph 6.3.2, page 60)

MLA (my listen address) bits L1 through L5 are set on the interface card (6010A-4008). This PCB is located behind the front panel. Access is gained by removal of the top cover. Table 4 lists listen addresses.

Explanation of IEEE488 Address Switch Operation

When a switch is in the lefthand position, that bit is set.

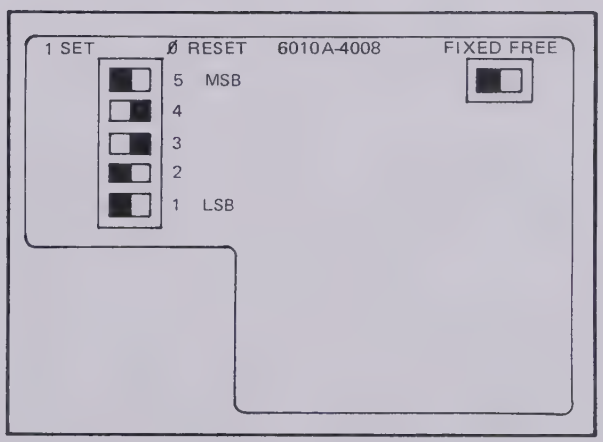
Table 4. ALLOWABLE LISTEN ADDRESSES

Binary No.	L5	L4	L3	L2	L1	ASCII	Character
0	0	0	0	0	0	SP	Space
1	0	0	0	0	1	!	exclamation mark
2	0	0	0	1	0	"	quotation mark
3	0	0	0	1	1	#	pound sign
4	0	0	1	0	0	$	dollar sign
5	0	0	1	0	1	%	per cent
6	0	0	1	1	0	&	and
7	0	0	1	1	1	'	apostrophe
8	0	1	0	0	0	(	left parenthesis
9	0	1	0	0	1	)	right parenthesis
10	0	1	0	1	0	*	asterisk
11	0	1	0	1	1	+	plus
12	0	1	1	0	0	,	comma
13	0	1	1	0	1	–	minus
14	0	1	1	1	0	.	decimal point
15	0	1	1	1	1	/	slant bar
16	1	0	0	0	0	Ø	zero
17	1	0	0	0	1	1	
18	1	0	0	1	0	2	
*19	1	0	0	1	1	3	
20	1	0	1	0	0	4	
21	1	0	1	0	1	5	
22	1	0	1	1	0	6	
23	1	0	1	1	1	7	
24	1	1	0	0	0	8	
25	1	1	0	0	1	9	
26	1	1	0	1	0	:	colon
27	1	1	0	1	1	;	semicolon
28	1	1	1	0	0	<	less than
29	1	1	1	0	1	=	equals
30	1	1	1	1	0	>	greater than

* Factory setting

This example has address switch set for 19; i.e.,

L number				
5	4	3	2	1
1	0	0	1	1



Selection of Fixed/Free Programming Format

This selection is also accomplished by a switch on the interface card. See above.

RS-232C Interface (Option –06)

This is a bit-serial binary data interface defined by EIA Standard RS-232C. Features include:

(1) Asynchronous data rates from 110 baud to 9600 baud.

(2) 20 mA non-isolated Teletype interface as well as Standard voltage level interface.

(3) 32 character first in, first out buffer memory to allow bursts of data at high rates.

(4) Unit will return a status character when ready for more data.

(5) Compatible with interface subsets A, B, C, D, and E (RS-232C, Section 5).

Voltage or Current Interface

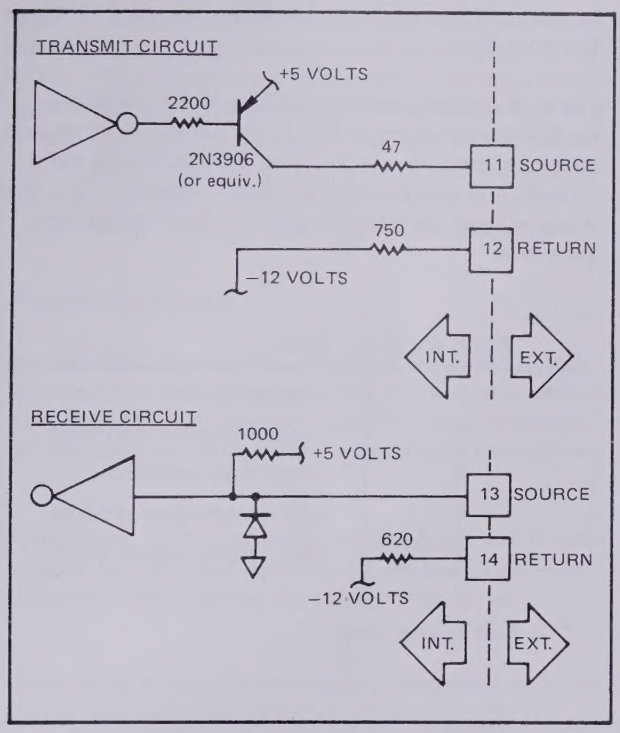
A selection must be made as to which type of Interface will be used: Standard RS-232C voltage levels, or 20mA current loop such as is used by Teletype machines. These interfaces are brought out on separate pins. See Table 5, (pin assignments). In addition, switch S1 on interface card 6010A-4010 located behind the front panel PCB must be set to the appropriate position. To gain access to this board, remove the top cover of the instrument.

The voltage interface, circuits BB and BA, are terminated and originated by type 8T16 and 8T15 integrated circuits, respectively. These I.C.'s are manufactured by Signetics.

Table 5. PIN ASSIGNMENTS

6011A Synthesized Signal Generator	6010A–4456 Adapter Cable Assembly Pin Assignments		RS-232C Description		
Function (Remote Connector J4 on rear panel)	"24 pin" Conn, J1	"25" pin" Conn. J2	Data Flow	Circuit	Description
SDI (Serial Data In)	6	3	←	BB	Rec'd Data
Signal Ground	5	7		AB	Signal Gnd
SDO (Serial Data Out)	7	2	→	BA	Transmitted Data
Send Source +	20	11	→		20 mA Transmitted
Send Return –	23	12	→		Data
Received Source +	12	13	←		20 mA Received
Received Return –	18	14	←		Data
Chassis Ground	24	1		AA	Protective Gnd
Remote Control Format	19 (Wired together)	N/C			
Signal Ground	11 (Wired together)	N/C			
$\overline{\text{REM}}$ (Remote Control Order)	9 (Wired together)	N/C			
	N/C	Wired together 8, 20	←	CF	Rec'd Line Sig. Det.
			→	CD	Data Term. Ready
	N/C	Wired together 4, 5	→	CA	Requst to send
			←	CB	Clear to Send
	N/C	6	←	CC	Data Set Ready
Grounded on Interface Card	17,21,22	N/C			
N/C	All other pins N/C	N/C All other pins			N/C

The 20 mA current loop interface circuits are shown below:



20 mA CURRENT LOOP CONVENTIONS

	LINE CURRENT	
	1 = 0mA	1 = 20 mA
BINARY STATE	1	Ø
SIGNAL CONDITION	Marking	Spacing

These circuits are referenced to chassis ground, (non-isolated), and require isolated (non-grounded) terminations in the data communication equipment or Teletype machine. Note that the 20 mA current sources are provided with this interface, and are inseparable from it. Be certain that sending and receiving circuits to which this interface is connected do not have any other 20mA current sources. Disconnect any external current sources.

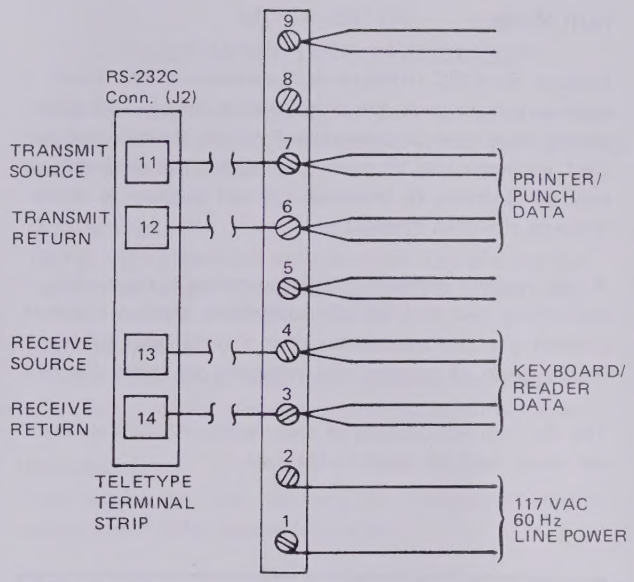
Recommended Method of Connection to Model ASR 33 Teletype Without Separate Hardware Reader Control.

Data Transfer Rates

Baud rates of 110, 150, 300, 600, 1200, 2400, 4800, and 9600 are selectable by wiring a jumper in socket X1 on the interface card (6010A-4010). This card is made accessible by removal of the top cover of the instrument. It is located behind the front panel.

Data Format

When this interface is shipped from the factory, data format is as follows:



No. of data bits - 8 including one allocated for parity.
No. of Start bits - 1
No. of Stop bits - 2
Parity bit - Ignored

By cutting jumpers on the interface card, (6010A-4010), one may alter the format required for received characters and transmitted characters.

These land patterns are adjacent to the UART I.C., U1, pins 35 through 39. These pins come factory wired to +5V dc.

1 = +5V dc 0 = gnd

U1 Pin No.	Function	No. of Data Bits 8	7	6	5
38	NB1	1	0	1	0
37	NB2	1	1	0	0

U1 Pin No.	Function	Type of Parity None		Even	Odd
39	EPS	1	0	1	0
35	NP	1	1	0	0

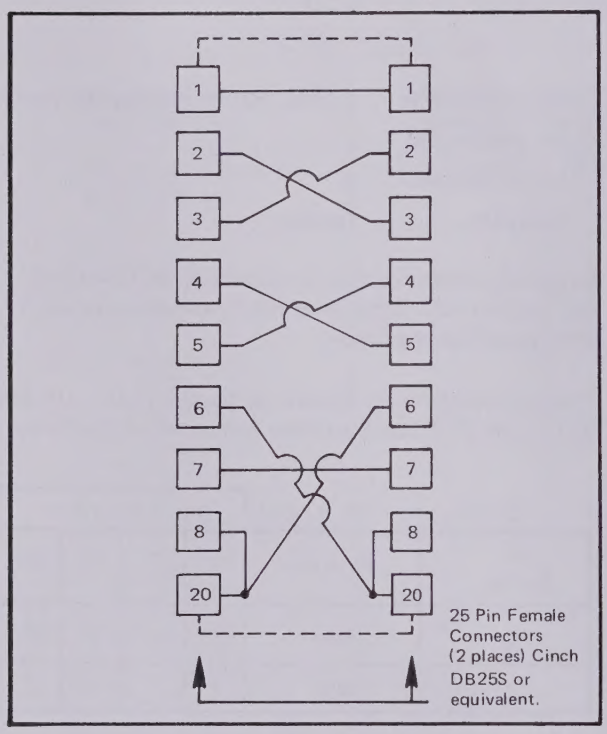
U1 Pin No.	Function	2 Stop bits	1 Stop bit
36	TSB	1	0

Null Modem

Because RS-232C defines a data communications device such as a modem as the only place a female connector can be used, and because data terminal devices such as CRT terminals can be used to program the generator, it may be desirable to implement a null modem to avoid rewiring standard connectors.

A null modem accessory device provides a means of connecting two EIA RS-232 compatible devices together without the implementation of a non-standard cable, or modification of connections internally to either device.

The null modem consists of two female RS-232 connectors wired back to back as follows:



Buffer Memory

Data received by this interface is buffered by a 32 character first in, first out memory. This allows a string of characters to be sent to the generator at high data rates without fear of losing a character due to generator processing time.

Provision has been made for status interrogation of the 6011A RS-232C interface, primarily to signal the controlling device that the memory is empty and ready for another string. This is done by sending a ? (question mark).

When the question mark is clocked out of memory and decoded, a numeric and cr (carriage return) is sent back to the controller, indicating that the generator is ready for more data.

Status of output amplitude settling (DAS), amplitude modulating signal level (ROL), and validity of frequency or level commands are indicated by ASCII data bits 1 through 4 in the returned numeric. Frequency and level status will not be returned when in fixed format programming.

ASCII Char	Status
0	everything OK
1	* invalid frequency command
2	* invalid level command
4	DAS (output level settling)
8	ROL (reduce output level)

* In Free Format only

Since it is assumed that the operator has sufficient skill to avoid sending invalid commands, status 1 and 2 should rarely occur.

Status 4 and 0 will be returned most often, and status 8 (ROL) is only possible during AM mode. Refer to the ASCII table for numerics indicating combinations of the above.

NOTE: Send a dummy character before the ? if? is sent as the last character in a string. This will allow the previous characters to be processed and status to be developed.

Example:

Set up 455kHz, −33 dBm with free format
String is cr 455E3H −33Y sp?
(cr = carriage return, sp = space)
answer from 6011A is 4 cr indicating D/A is settling

Before more data will be recognized, a cr (carriage return) must be returned by the controller to the generator. Controllers with an echo-back mode on their I/O ports satisfy this requirement. If the controller does not echo back characters sent to it, begin each new string with a cr if you ended the previous string with a question mark.

Remote/Local Control

When the RS-232C adapter cable (6010A-4456) is plugged into the remote control connector on the rear panel of the 6011A, the generator is called into remote control. This is accomplished by a jumper wire on connector J1 of the adapter cable between pins 11 and 9. See Table 4. This jumper may be cut, and pin 9 wired to a TTL gate or switch to select remote or local. Pin 9 will rise to +5V dc when open, and 2.3 mA will flow out of pin 9 when shorted to ground.

Programing Format

The RS-232C adapter cable (6010A-4456) comes factory-wired for Free Format programming. If the jumper wire (in J1 of the cable) between pins 11 and 19 is cut, the generator will recognize Fixed Format programming instructions.

Alternatively, pin 19 may be wired to a switch or TTL gate to select format. When open, pin 19 will be at a potential of +5V dc. When shorted, 2.1 mA will flow out of it.

If the switch is used to select format, it should be set to the desired position before power is applied to the unit.

6010A/6011A
RACK MOUNTING KITS/SLIDES

These half rack width signal generators may be mounted in left offset, right offset, center mount, or dual configurations with or without slides.

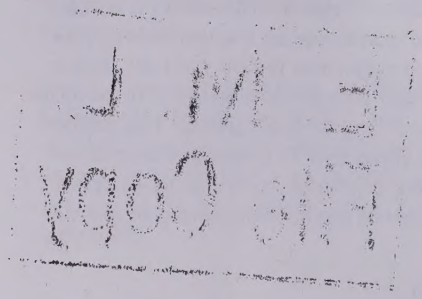
M05-203-601
Left or right offset rack mounting kit Use of slides not possible; generator should be supported at side or rear.

M05-203-602
Centered rack mounting kit for one instrument. Use of slides not possible; generator should be supported at rear.

M05-200-603
Dual side-by-side rack mounting kit. Instruments must be supported at sides, rear or with slides.

M00-260-610
18" chassis slides for use with dual side-by-side rack mounting kit.

M00-203-631
Left or right offset rack mounting kit including 18" chassis slides. Mounts one generator.



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